

## CROSS-REFERENCE TO RELATED APPLICATION

This application claims the priority benefit of Taiwan application serial no.

10 92122063, filed on August 12, 2003.

## BACKGROUND OF THE INVENTION

## Field of the Invention

[0001] This invention generally relates to a cold cathode fluorescent flat lamp, and more  
15 particularly to a cold cathode fluorescent flat lamp for separating each group of plasma  
produced by each electrode pair to prevent cross-talk state.

## Description of the Related Art

[0002] As technology advances, digital devices such as mobile phones, digital cameras,  
notebook computers, desktop computers are developed to provide multi-functions and  
20 easiness to use. For such devices, a display is an indispensable interface for the users  
to communicate with. Most of such digital devices use LCD panels as their displays in  
the past years. However, a back light module is required for a LCD panel because the  
LCD panel itself is not self-emitting.

[0003] Since a cold cathode fluorescent flat lamp can provide a good light-  
25 emitting efficiency and uniformity, and is a better light source for a larger panel, it had  
been well applied to the back light modules for LCD panels and other applications. A  
cold cathode fluorescent flat lamp is a plasma light-emitting device where a high  
voltage waveform is applied between electrodes to excite the inert gas in the discharge

5 space to high-energy excited molecules, ions, and electrons. Those high-energy excited molecules, ions, and electrons are so-called plasma. The plasma will emit the ultraviolet rays to release the energy and to further excite the fluorescent materials in the cold cathode fluorescent flat lamp, thereby emitting the visible light.

[0004] FIG. 1 is a structural view of a conventional cold cathode fluorescent flat lamp. The cold cathode fluorescent flat lamp 100 comprises a first substrate 110, a second substrate 120, a side wall 130, a plurality of electrode pairs 140 (FIG. 1 shows 3 electrode pairs as an example), a fluorescent material 150, and a discharge gas 160. The side wall 130 is disposed at the edge of cold cathode fluorescent flat lamp 100 between the first substrate and the second substrate to form a gas discharge space 170. In addition, a plurality of spacers can be disposed between the substrates to reinforce the structural strength at the central part of the cold cathode fluorescent flat lamp 100.

[0005] Referring to FIG. 1, the electrode pair 140 includes an X electrode 140a and a Y electrode 140b. The X electrode 140a and the Y electrode 140b are usually strip electrodes that are disposed in parallel on the first substrate 110. A dielectric layer 180 will usually be disposed on the electrode pair 140 to protect the electrode pair 140 from ion impacts. Further, the discharge gas 160 such as Xe, Ne, Ar, or mixture thereof, is injected into the gas discharge space 170. In addition, the fluorescent material is disposed on the inner wall of the gas discharge space 170 such as the surface of the second substrate 120 or the dielectric layer 180.

25 [0006] The process to turn on the cold cathode fluorescent flat lamp 100 is to apply a high voltage waveform between the X electrode and the Y electrode of the electrode pairs to excite the inert gas to a plasma state. Those excited atoms will emit the ultraviolet rays to release the energy and to further excite the fluorescent material 150

5 on the inner wall of the gas discharge space 170. However, the electrodes of the conventional cold cathode fluorescent flat lamp are placed in the same gas discharge space. That is, the discharge gas could flow through all the electrodes. During the blink mode, some plasma will flow to a non-emitting area and cause interference so that the individual electrode pair cannot be precisely controlled.

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#### SUMMARY OF THE INVENTION

[0007] An object of the present invention is to provide a cold cathode fluorescent flat lamp, wherein a plurality of barrier ribs is disposed to separate the plasma generated by the electrode pairs, and also to increase the surface areas of the fluorescent material.

15 Thus, the cross-talk effect during the discharge period can be prevented and the light-emitting efficiency and uniformity can also be enhanced.

[0008] In accordance with the above object and other advantages, the present invention provides a cold cathode fluorescent flat lamp. The cold cathode fluorescent flat lamp of the present invention comprises a first substrate, a plurality of electrode pairs, wherein the plurality of electrode pairs being disposed on the first substrate, each of the plurality of electrode pairs includes an X electrode and a cathode; a second substrate disposed above the first substrate; a plurality of barrier ribs disposed between the first substrate and the second substrate forming a plurality of gas discharge spaces between the first substrate and the second substrate, wherein each of the gas discharge spaces comprises an electrode pair; a fluorescent material disposed on inner walls of the plurality of gas discharge space; and discharge gas sealed in the plurality of gas discharge space.

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[0009] In a preferred embodiment of the present invention, the plurality of barrier

5 ribs is comprised of stripes. The width of the bottom of the barrier ribs is wider than a width of the top of the barrier ribs. The cross section of each of the barrier ribs is comprised of a triangle or a trapezoid. Further, the material of the barrier ribs is comprised of, for example, a dielectric material.

[0010] In a preferred embodiment of the present invention, the X electrodes of the  
10 plurality of electrode pairs are connected in parallel to provide the same voltage waveform. The Y electrodes of the plurality of electrode pairs are connected in parallel to provide the same voltage waveform. Further, the electrode pairs are disposed in an order of the X electrode and the Y electrode alternately on the first substrate.

15 [0011] In a preferred embodiment of the present invention, a dielectric layer is disposed on the plurality of electrode pairs and a portion of the fluorescent material to protect the electrode pairs from ion impacts.

[0012] In a preferred embodiment of the present invention, the discharge gas in the gas discharge space is an inert gas such as one of Xe, Ne, Ar, and a mixture thereof.  
20 The electrode pairs are comprised of metal such as Ag, Cu, or Cr-Cu-Cr alloy.

[0013] In a preferred embodiment of the present invention, a plurality of barrier ribs are disposed between two substrates and each of the electrode pairs is disposed into the gas discharge space, wherein each electrode pair is separated from the other electrode pair by the barrier ribs. Hence, during the on/off operation of the individual electrode  
25 pair, the plasma will not flow to a non-emitting area to cause cross-talk effect. Further, the surface areas of the fluorescent material can be increased by coating the fluorescent material on the barrier ribs, thereby enhancing the light-emitting efficiency and uniformity of the cold cathode fluorescent flat lamp.

5 [0014] The above is a brief description of some deficiencies in the prior art and advantages of the present invention. Other features, advantages and embodiments of the invention will be apparent to those skilled in the art from the following description, accompanying drawings and appended claims.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is a structural view of a conventional cold cathode fluorescent flat lamp.

[0016] FIG.2 is a structural view of a cold cathode fluorescent flat lamp according to a preferred embodiment of the present invention.

15 [0017] FIGs.3A-3B show the arrangement of the electrode pairs in accordance with a preferred embodiment of the present invention.

[0018] FIGs.4A-4B show the shapes of barrier ribs in accordance with a preferred embodiment of the present invention.

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#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] FIG.2 is a structural view of a cold cathode fluorescent flat lamp according to a preferred embodiment of the present invention. Referring to FIG. 2, the cold cathode fluorescent flat lamp 200 comprises a first substrate 210, a plurality of electrode pairs 220, a second substrate 230, a plurality of barrier ribs 240, a fluorescent material 250,  
25 and a discharge gas 260. The plurality of electrode pairs 220 are disposed on the first substrate 210. Each of the plurality of electrode pairs 220 includes an X electrode 220a and a Y electrode 220b. Those electrodes are comprised of parallel stripes. The electrode material is comprised of a metal, such as Ag, Cu and Cr-Cu-Cr alloy.

5 [0020] Referring to FIG. 2, a second substrate is disposed over the first substrate. The first substrate 210 and the second substrate 230 are comprised of, for example, glass. The plurality of barrier ribs 240 are disposed between the first substrate 210 and the second substrate 230 to form a plurality of gas discharge space 270. Each of the plurality of electrode pairs 220 corresponds to each of the plurality of gas discharge space 270. The fluorescent material 250 is disposed on inner walls of the plurality of gas discharge space 270, such as the surfaces of the first substrate 210 and the second substrate 230. The discharge gas 260 is injected in the plurality of gas discharge space 270. Further, a dielectric layer 280 is disposed on the electrode pairs 220 to protect the electrodes of the electrode pair 220 from ion impacts. In addition, the barrier ribs 240 can be comprised of dielectric materials to protect themselves from ion impacts.

[0021] To light up the cold cathode fluorescent flat lamp 200, a high voltage waveform is applied between the X electrode and the Y electrode of the electrode pairs 220 to excite the discharge gas 260 in the gas discharge space 270 to the plasma state which includes excited molecules, ions and electrons. Subsequently, the plasma will emit the ultraviolet rays to release the energy and to further excite the fluorescent material 250 on the inner wall of the gas discharge space 270. It should be noted that each electrode pair is separated by the barrier ribs 240 so that the plasma generated by the individual electrode pair only releases the energy within its own gas discharge space 270 and will not flow to the other gas discharge spaces 270. Hence, the plasma will not flow to an un-emitting area to cause cross-talk effect. Further, the surface areas of the fluorescent material can be increased by coating the fluorescent material on the barrier ribs, thereby enhancing the light-emitting efficiency and uniformity of the cold cathode fluorescent flat lamp 200.

5 [0022] FIGs.3A-3B show the arrangement of the electrode pairs in accordance with a preferred embodiment of the present invention. Referring to FIG. 3A, the electrode pairs 220 can be arranged in an order of X electrode 220a, Y electrode 220b, X electrode 220a, and Y electrode 220b on the first substrate 210. Such an arrangement allows different types electrodes to be disposed on the different sides of the barrier ribs 240. Referring to FIG. 3B, the electrode pairs 220 can be arranged in an order of X electrode 220a, Y electrode 220b, Y electrode 220b and X electrode 220b, on the first substrate 210. Such an arrangement allows same type of electrodes disposed on the different sides of the barrier ribs 240.

[0023] It should be noted that when the electrodes on the two sides of the barrier ribs 240 are of same type, as shown in FIG. 3B, it could prevent the barrier ribs 240 from breakdown. Hence, the electrodes on the two sides of the barrier ribs 240 can be arranged closer to the barrier ribs 240 to increase the discharge area.

[0024] Further, the same electrodes of the electrode pairs 220 can be connected in parallel to provide the same voltage waveform. For example, the X electrodes 220a of the electrode pairs 220 can be connected in parallel (not shown); and the Y electrodes 220b of the electrode pairs 220 can be connected in parallel. Further, the electrode (the X electrode 220a and the Y electrode 220b) of the electrode pairs 220 can be directed to the same side (not shown) so that the driving circuit need not be connected to two sides of the lamp.

25 [0025] FIGs.4A-4B show barrier ribs in accordance with a preferred embodiment of the present invention. The width of the bottom of the barrier ribs 240 is wider than the width of the top of the barrier ribs 240. The cross section of each of the plurality of barrier ribs is comprised of a triangle (as shown in FIG. 4A) or a trapezoid (as shown in

5 FIG. 4B). This design can reduce blocking of the light output by the barrier ribs 240 and thereby a better light uniformity is achieved.

[0026] In brief, the present invention at least provides the following advantages:

[0027] By disposing a plurality of barrier ribs between two substrates to separate each electrode pair, the plasma will not flow to an un-emitting area during the on/off  
10 operation of the individual electrode pair to cause cross-talk effect. Thus, the light-emitting efficiency and the uniformity of the cold cathode fluorescent flat lamp can be effectively promoted.

[0028] The barrier ribs also provide support to reinforce the structure at the central part of the cold cathode fluorescent flat lamp 100. Hence, the barrier ribs can replace  
15 the conventional spacers.

[0029] The above description provides a full and complete description of the preferred embodiments of the present invention. Various modifications, alternate construction, and equivalent may be made by those skilled in the art without changing the scope or spirit of the invention. Accordingly, the above description and  
20 illustrations should not be construed as limiting the scope of the invention which is defined by the following claims.